Marginal gains in yield per recruit at F levels above $F_{0.1}$ (Gulland 1977: p. 10) are relatively minor; greater than 92% of maximum yield per recruit is achieved at $F_{0.1}$ in any of the areas for any of the four meat counts (Figure 39). Moreover, fishing at $F_{0.1}$ provides a higher yield per recruit than is attained for most F values above 0.5. Accordingly, substantial reductions in current fishing mortality rates could ensue and be accompanied by increases rather than losses in yield per recruit without any change in meat count. The greatest gains, however, would be effectuated by concurrent reductions in both fishing mortality and meat count (Table 47).

Assessment Implications and Projected Outlook

The Northwest Atlantic sea scallop fishery is currently in a transitional state. Total annual USA and Canadian landings from Georges Bank, the Mid-Atlantic, and the Gulf of Maine during 1976-1981 were the highest on record; total landings, however, declined 33% between 1978 and 1980. Landings in 1981 were slightly higher than in 1980 (19,475 vs 17,805 tons) due to increased effort in the Georges Bank fishery where landings rose by nearly 50%. Mid-Atlantic and Gulf of Maine landings declined by 59% and 33%, respectively, between 1980 and 1981, with Mid-Atlantic landings being the lowest in seven years.

During 1976-1980, annual nominal effort in each of the principal sea scallop fisheries sequentially increased, with the 1980 values in all areas the highest ever recorded. Initially, effort increases were in response to significantly improved resource abundance on Georges Bank and in the Mid-Atlantic resulting from outstanding recruitment of the 1972 year class. In the Gulf of Maine, newly discovered offshore beds prompted increases in exploitation. Apart from the Northern Edge and Peak region of Georges Bank, subsequent scallop recruitment has

been much poorer and more localized. Resultingly, commercial catch per unit effort values have sharply declined; between 1978 and 1980, Georges Bank and Mid-Atlantic commercial CPUE indices decreased by about 50%. Equally pronounced reductions have been evident in research survey relative abundance indices. The 1981 research survey recruit (commercial size) catch per tow values in all areas except the Northern Edge and 61-100 fm depth zone in the Gulf of Maine were either the lowest or among the lowest ever obtained. Fishing effort, however, has remained high, stimulated in part, by a 2.4-fold increase in ex-vessel prices between 1977 and 1980.

In 1981, USA Georges Bank landings increased to their highest level in 18 years as a consequence of intense fishing activity on the Northern Edge and Peak sustained almost exclusively by recruitment from the 1977 year class. Approximately 62% of the USA Georges Bank catch was derived from the Northern Edge region, the highest proportion since 1962. For the first time since 1971, Georges Bank landings comprised more than half of the total USA sea scallop harvest. Although Canadian Georges Bank landings increased from 1980 to 1981 (again resulting from Northern Edge and Peak catches), the USA fishery accounted for greater than 50% of the total Georges Bank landings in 1981, only the second time (the first was in 1980) since 1964 that this has occurred. Average meat counts in both the USA and Canadian 1981 Georges Bank landings were well above historical levels, with the mean size of scallops in the USA landings the smallest in the 1965-1980 period. This reduction in cull size was precipitated by dependence on incoming recruitment from the 1977 year class, by a relative scarcity of larger-sized scallops on the Northern Edge (due presumably to heavy fishing mortality), and by the absence (USA) and liberalization (Canada) of meat size regulations. The available evidence suggests that, in spite of exceptional recruitment, fishing mortality on Georges Bank in 1981 was extremely high.

appearance of many Mid-Atlantic based vessels on Georges Bank in 1981 is the reduction in almost all Mid-Atlantic research survey indices imply source abundance in the southern regions has continued to subside. There o indication in either the survey or commercial size frequency distributions any significant recruitment of the magnitude that sustained the Mid-Atlantic shery during 1976-1980. The large reduction in Mid-Atlantic landings during 1981 is the most apparent manifestation of the diminished population levels.

As in 1980, the Gulf of Maine scallop fishery was dominated by offshore landings in 1981, a relatively recent phenomenon since traditionally territorial water landings have accounted for almost all of the Gulf of Maine commercial scallop catch. However, landings in 1981 were primarily derived from beds much further north then the ones exploited during 1980. This shift in the areal distribution of the 1981 landings suggests that fishing mortality in 1980 rapidly reduced standing stock biomass in the areas fished. Since the recent landings have been supported by single year classes, it is likely that current catch levels cannot be maintained unless additional high density beds are located. In this regard, relative abundance indices from USA spring and autumn bottom trawl surveys in the Gulf of Maine indicate that such beds exist in depths between 61-100 fm. The long-term productivity of these beds is not known although they are believed to be virtually unexploited at present. These deeper water populations should be accessible to Class 3 and 4 vessels which accounted for the majority of the Gulf of Maine landings during 1980 and 1981. Gear modifications will need to be made, however, in order to fish at these greater depths.

The current status and 1982 recruitment prospects for the New England and Mid-Atlantic sea scallop resources are summarized in Table 48. Apart from the Northern Edge and Peak and deepwater Gulf of Maine regions, incoming recruitment

in the immediate future will be poor or relatively low. Recruitment of the 1978 year class to the Northern Edge fishery in 1981 will be significant although this cohort appears to be less than half the size of the exceptional 1977 year class. Since the relative abundance of the 1978 year class on the Northern Edge and Peak is substantially higher than total relative abundance values in all other regions, it is likely that both the USA and Canadian fleets will continue (as in 1981) to concentrate their scallop efforts in this area of Georges Bank. In the absence of effective constraints on size at capture of scallops, meat counts in the 1982 fishery could be as high as those observed in 1981. Emergency implementation of the USA Fishery Management Plan for sea scallops in May 1982, however, is directed toward obviating this condition. Should landing levels remain at the 1981 level, further increases in fishing mortality are anticipated since the 1978 year class is no more than half as large as the 1977 year class which sustained the fishery in 1981. This situation will additionally be exacerbated if displacement of effort from other scallop regions to the Northern Edge continues to ensue. Lack of compliance in 1982 with the recently implemented measures of the USA Sea Scallop Management Plan may result in further losses in yield per recruit and resource reproductive potential, increasing the risks attendant with growth overfishing and elevating the likelihood of recruitment overfishing.

Depressed resource abundance levels in the Mid-Atlantic coupled with a lack of significant incoming recruitment suggest that recent landings levels (1976-1980) cannot be maintained in the near term. While there is a possibility of significant improvement in population biomass in the New York Bight region in 1983 should the initial indications of a better than average 1979 year class be realized, present abundant levels will continue to decline throughout the Mid-Atlantic unless effort is curtailed.

The prognosis for the offshore Gulf of Maine fishery is equivocal. Sustained high yields from the offshore beds fished during 1980-81 appear improbable. Exploitation on these populations has been accompanied by high fishing mortality rates, rapidly effecting abundance declines. A possibility exists, however, for a deep-water fishery in 61-100 fm where accumulated biomass appears relatively high. The potential long-term yield from these beds, however, is unknown.

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